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A method for extracting kinetic freeze-out temperature of interacting system

In the framework of multisource thermal model, we describe experimental results of the transverse momentum spectra of final-state light flavor particles produced in gold–gold (Au–Au), copper–copper (Cu–Cu), lead–lead (Pb–Pb),proton–lead (p–Pb), and proton–proton (p–p) collisions at various energies,measured by the PHENIX, STAR, ALICE, and CMS Collaborations. By using Tsallis-standard (Tsallis form of Fermi–Dirac or Bose–Einstein), Tsallis, two- or three-component standard distributions and the multi-component Erlang Distribution,the effective temperature and real temperature (kinetic freeze-out temperature) of the interacting system at the stage of kinetic freeze-out, the mean transverse flow velocity and mean flow velocity of particles, and the relationships between them are extracted. A central parameter in the four distributions is the effective temperature which contains information on the kinetic freeze-out temperature of the emitting source and reflects the effects of random thermal motion of particles as well as collective expansion of the source. To disentangle both effects, we extract the kinetic freeze-out temperature from the intercept of the effective temperature (T) curve as a function of particle’ s rest mass (m_0) when plotting T versus m_0, and the mean transverse flow velocity from the slope of the mean transverse momentum ($\langle p_T \rangle$) curve as a function of mean moving mass ($\overline{m}$) when plotting $\langle p_T \rangle$ versus $\overline{m}$. The dependences of effective temperature and mean (transverse) momentum on rest mass, moving mass,centrality, and center-of-mass energy, and the dependences of kinetic freeze-out temperature and mean (transverse) flow velocity on centrality, center-of-mass energy, and system size are obtained.

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